

## Effect of Intake on Compressor Performance

The effect of intake air on compressor performance should not be underestimated. Intake air that is contaminated or hot can impair compressor performance and result in excess energy and maintenance costs. If moisture, dust, or other contaminants are present in the intake air, such contaminants can build up on the internal components of the compressor, such as valves, impellers, rotors, and vanes. Such build-up can cause premature wear and reduce compressor capacity.

When inlet air is cooler, it is also denser. As a result, mass flow and pressure capability increase with decreasing intake air temperatures, particularly in centrifugal compressors. This mass flow increase effect is less pronounced for lubricant-injected, rotary-screw compressors because the incoming air mixes with the higher temperature lubricant. Conversely, as the temperature of intake air increases, the air density decreases and mass flow and pressure capability decrease. The resulting reduction in capacity is often addressed by operating additional compressors, thus increasing energy consumption.

To prevent adverse effects from intake air quality, it is important to ensure that the location of the entry to the inlet pipe is as free as possible from ambient contaminants, such as rain, dirt, and discharge from a cooling tower. If the air is drawn from a remote location, the inlet pipe size should be increased in accordance with the manufacturer's recommendation to prevent pressure drop and reduction of mass flow. All intake air should be adequately filtered. A pressure gauge indicating pressure drop in inches of water is essential to maintain optimum compressor performance.

When an intake air filter is located at the compressor, the ambient temperature should be kept to a minimum, to prevent reduction in mass flow. This can be accomplished by locating the inlet pipe outside the room or building. When the intake air filter is located outside the building, and particularly on a roof, ambient considerations are important, but may be less important than accessibility for maintenance in inclement or winter conditions.

### How to Select an Intake Air Filter

A compressor intake air filter should be installed in, or have air brought to it from a clean, cool location. The compressor manufacturer normally supplies, or recommends, a specific grade of intake filter designed to protect the compressor. The better the filtration at the compressor inlet, the lower the maintenance at the compressor. However, the pressure drop across the intake air filter should be kept to a minimum (by size and by maintenance) to prevent a throttling effect and a reduction in compressor capacity. A pressure differential gauge is one of the best tools to monitor the condition of the inlet filter. The pressure drop across a new inlet filter should not exceed 3 pounds per square inch (psi).

### Inlet Filter Replacement

As a compressor intake air filter becomes dirty, the pressure drop across it increases, reducing the pressure at the air end inlet and increasing the compression ratios. The cost of this loss of air can be much greater than the cost of a replacement inlet filter, even over a short period of

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time. For a 200 horsepower (hp) compressor operating two shifts, 5 days a week (4,160 hours per year) with a \$0.05/kilowatt hour (kWh) electricity rate, a dirty intake filter can decrease compressor efficiency by 1%–3%, which can translate into higher compressed air energy costs of between \$327 and \$980 per year.

FOR ADDITIONAL INFORMATION, PLEASE CONTACT:

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